INDOOR AIR QUALITY ASSESSMENT

Mount Everett High School
South Berkshire Regional School District
491 Berkshire School Road
Sheffield, Massachusetts

Prepared by:
Massachusetts Department of Public Health
Bureau of Environmental Health Assessment
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Background/Introduction

At the request of Frederick Finkle, Director of Buildings and Grounds for the Southern Berkshire Regional School District, the Massachusetts Department of Public Health (MDPH), Bureau of Environmental Health Assessment (BEHA), provided assistance and consultation regarding indoor air quality issues and health concerns at the Mount Everett Regional High School, 491 Berkshire School Road, Sheffield, Massachusetts. On April 3, 2002, a visit was made to this school by Mike Feeney, Director of BEHA's Emergency Response/Indoor Air Quality program.

The Mount Everett Regional High School is part of a larger school complex that includes the Undermountain Elementary School. This report describes the conditions noted within the Mount Everett Regional High School only. The indoor air quality assessment of Undermountain Elementary School is subject of a separate report.

The high school is a two-story, red brick structure. The building underwent renovations in 1993. Classrooms have openable windows.

Methods

Air tests for carbon dioxide, temperature and relative humidity were taken with the TSI, Q-Trak, IAQ Monitor, Model 8551.

Results

This school has a student population of approximately 480 and a staff of approximately 40. Tests were taken during normal operations at the school and results appear in Tables 1-4.

Discussion

Ventilation

It can be seen from the tables that carbon dioxide levels were elevated above 800 ppm (parts per million) in four of thirty-seven areas surveyed, which may be indicative of a ventilation problem in some sections of the school. It is also important to note that some classrooms had open windows during the assessment, which can greatly contribute to reduced carbon dioxide levels.

Fresh air in classrooms is supplied by a unit ventilator (univent) system. Univents draw air from outdoors through a fresh air intake located on the exterior walls of the building and return air through an air intake located at the base of each unit (see Figure 1). Fresh and return air are mixed, filtered, heated and provided to classrooms through a fresh air diffuser located in the top of the unit. Univents were operating in all but one classroom (see Tables). In room H24, a rooftop exhaust vent is located in close proximity to the univent fresh air intake (see Picture 1). Under certain wind condition, materials exhausted from this vent may be entrained by the H24 univent.

Exhaust ventilation in classrooms is provided by a mechanical exhaust system. Exhaust vents are located along interior hallway walls of classrooms. In some cases, classroom exhaust vents located above wall-mounted cabinets can become prone to blockage by stored materials. No blockages of exhaust vents were observed.

To maximize air exchange, the BEHA recommends that both supply and exhaust ventilation operate continuously during periods of school occupancy. In order to have proper ventilation with a mechanical supply and exhaust system, the systems must be balanced to provide an adequate amount of fresh air to the interior of a room while removing stale air from the room. According to school department officials, the date of the last balancing of these systems was not available at the time of the assessment. It is recommended that existing ventilation systems be re-balanced every five years to ensure adequate air systems function (SMACNA, 1994).

The Massachusetts Building Code requires a minimum ventilation rate of 15 cubic feet per minute (cfm) per occupant of fresh outside air or have openable windows in each room (SBBRS, 1997; BOCA, 1993). The ventilation must be on at all times that the room is occupied. Providing adequate fresh air ventilation with open windows and maintaining the temperature in the comfort range during the cold weather season is impractical. Mechanical ventilation is usually required to provide adequate fresh air ventilation.

Carbon dioxide is not a problem in and of itself. It is used as an indicator of the adequacy of the fresh air ventilation. As carbon dioxide levels rise, it indicates that the ventilating system is malfunctioning or the design occupancy of the room is being exceeded. When this happens a buildup of common indoor air pollutants can occur, leading to discomfort or health complaints. The Occupational Safety and Health Administration (OSHA) standard for carbon dioxide is 5,000 parts per million parts of air (ppm). Workers may be exposed to this level for 40 hours/week based on a time-weighted average (OSHA, 1997).

The Department of Public Health uses a guideline of 800 ppm for publicly occupied buildings. A guideline of 600 ppm or less is preferred in schools due to the fact that the majority of occupants are young and considered to be a more sensitive population in the evaluation of environmental health status. Inadequate ventilation and/or elevated temperatures are major causes of complaints such as respiratory, eye, nose and throat irritation, lethargy and headaches. For more information concerning carbon dioxide, please see Appendix I.

Temperature readings recorded during the assessment ranged from 71 ^{o}F to 76 ^{o}F, which were within BEHA's recommended comfort range. The BEHA recommends that indoor air temperatures be maintained in a range of 70 ^{o}F to 78 ^{o}F in order to provide for the comfort of building occupants. In many cases concerning indoor air quality, fluctuations of temperature in occupied spaces are typically experienced, even in a building with an adequate fresh air supply.

Relative humidity measurements ranged from 37 to 44 percent, which were within or close to BEHA comfort guidelines. The BEHA recommends that indoor air relative humidity is comfortable in a range of 40 to 60 percent. The sensation of dryness and irritation is common in a low relative humidity environment. Humidity is difficult to control during the winter heating season. Low relative humidity is a very common problem during the heating season in the northeast part of the United States.

Microbial/Moisture Concerns

The library had a large potted plant located on wall-to-wall carpeting (see Picture 2). Plant soil and drip pans can serve as sources of mold growth. Plants should have drip pans and over-watering of plants should be avoided. Drip pans should be inspected periodically for mold growth. Plants should also be located away from univents to prevent the aerosolization of mold, dirt and pollen.

Water damaged ceiling tiles were noted in several areas (see Tables). If porous materials (e.g., ceiling tiles and carpeting) become wet repeatedly they can provide a medium for mold growth. The American Conference of Governmental Industrial Hygienists (ACGIH) recommends that porous materials be dried with fans and heating within 24 hours of becoming wet (ACGIH, 1989). If porous materials are not dried within this time frame, mold growth may occur. Water-damaged porous materials cannot be adequately cleaned to remove mold growth. The application of a mildewcide to moldy porous materials is not recommended as a solution.

The greenhouse is designed to retain heat and moisture to aid the growing of plants. This room would have a higher relative humidity than other areas in the building. With increased exposure to moisture, soil and porous materials (e.g., cardboard, wood, paper, ceiling tiles and cloth) can serve as potential mediums for mold growth. The exhaust fans in the greenhouse were deactivated. The access door to the greenhouse was wedged open, which can allow for greenhouse odors/moisture to migrate into classrooms.

Other Concerns

Several other conditions that can potentially affect indoor air quality were also identified. Univents were spot checked throughout the school complex. In some cases, the univent filter was removed and found to be smaller than the filter rack (see Picture 3). Filters should be of sufficient size to fit flush into the entire rack. If filters do not fit flush with filter racks, air drawn into the univent will bypass filters and pass through spaces between filters and racks. This can result in dust, dirt and other debris being distributed by the ventilation system.

In an effort to reduce noise from sliding chairs, tennis balls are sliced open and placed on stool legs (see Picture 4). Tennis balls are made of a number of materials that can be a source of respiratory irritants. Constant wearing of tennis balls can produce fibers and off-gassing volatile organic compounds (VOCs). Tennis balls are made with a natural rubber latex bladder, which becomes abraded when used as a chair leg pad. Use of tennis balls in this manner may introduce latex dust into the school environment. Some individuals are highly allergic to latex (e.g., spina bifida patients) (SBAA, 2001). It is recommended that the use of materials containing latex be limited in buildings to reduce the likelihood of symptoms in sensitive individuals (NIOSH, 1997). A question and answer sheet concerning latex allergy is attached as Appendix II (NIOSH, 1998).

A number of classrooms contained dry erase boards and dry erase board markers. Materials such as dry erase markers and dry erase board cleaners may contain VOCs (e.g. methyl isobutyl ketone, n-butyl acetate and butyl-cellusolve) (Sanford, 1999). Cleaning products were found on floors, counter-tops and beneath sinks in a number of classrooms. Cleaning products and dry erase board markers and cleaners contain chemicals that can be irritating to the eyes, nose and throat of sensitive individuals.

A noticeable odor of wood dust was detected in the hallway outside the door to the wood shop. Spaces were noted at the bottom and between hallway doors, which can allow for saw dust and other pollutants to migrate from the shop to the hallway. The shop has a wood dust collection system. The dust collector is located outdoors, in close proximity to the fresh air intake for the univent in room E1 (see Picture 5). As air is vented from this collector fine wood dust may be entrained by this univent fresh air intake and introduced to occupied space.

Room D1 contained a jewelry kiln on a counter (see Picture 6). While a general exhaust system exists in these rooms, no dedicated local exhaust ventilation was provided for this machinery. Kilns can produce metal fumes, dust, smoke and odors, which should be vented outdoors. Of note is the cleanliness of the pottery classroom. Over the course of numerous high school inspections, few pottery classrooms have been found as free of accumulated clay dust as in this room.

A container of flammable material was stored outside the flameproof cabinet in the wood shop (see Picture 7). Flammable materials should be stored in a cabinet that meets the requirements of the National Fire Prevention Association (NFPA) (NFPA, 1996).

Science classrooms are equipped with bubbler type eyewash stations (see Picture 8). Each of these eye wash stations is equipped with a drain trap. Without periodic water poured into the drain, the traps on the eye wash station may dry out, which can result in sewer gas migration into science classrooms. Sewer gas can contain hydrogen sulfide, which is an irritant to eyes, nose and the respiratory system.

Conclusions/Recommendations

In view of the findings at the time of our inspection, the following recommendations are made:

1. Remove materials blocking univents and ensure exhaust vents remain free of obstructions.
2. Examine univents throughout the school for function. Survey classrooms for air diffuser and exhaust vent function to ascertain if an adequate air supply exists for each room. Check fresh air intakes for repair and increase the percentage of fresh air intake if necessary.
3. Ensure that filters in univents are of proper size. Examine the filters in the univents and air handling units (AHUs) in common areas (e.g. auditorium and gym) and change these filters on a regular basis. Consider increasing the dust spot efficiency of filters to increase the removal of particulates from the environment.
4. Once fresh air supply and exhaust systems are functioning, consider having the systems balanced by a ventilation engineer.
5. Examine the feasibility of extending the exhaust vent in Picture 1 a minimum of two feet above the high level of the classroom windows to prevent odor migration.
6. Install weather stripping around the door frame and door sweeps at the bottom of and between wood shop hallway doors to serve as a barrier.
7. Examine the feasibility of installing a hood on top of the wood dust collector to direct exhaust air away from the univent fresh air intake.
8. Operate the greenhouse exhaust fans during school hours to vent odors from this space. Keep classroom access door to greenhouse closed during school hours.
9. For buildings in New England, periods of low relative humidity during the winter are often unavoidable. Therefore, implementation of scrupulous cleaning practices to minimize common indoor air contaminants, whose irritant effects can be enhanced when the relative humidity is low, should be implemented. Among these methods can be the use of vacuum

cleaning equipment outfitted with a high efficiency particulate arrestance filter (HEPA). Drinking water during the day can help ease some symptoms associated with a dry environment (throat and sinus irritations).

10. Remove plants from carpeted floor in library. Examine carpet underneath planter for mold growth. If moldy, remove/replace contaminated section of carpet. Disinfect non-porous areas with an appropriate antimicrobial where necessary.
11. Replace water damaged ceiling tiles. Determine source of water wetting ceiling tiles and remediate. Disinfect non-porous areas with an appropriate antimicrobial where necessary.
12. Move jewelry kiln into kiln room to provide exhaust ventilation.
13. Pour water into eye wash drains on a regular basis to keep traps wet.
14. Have a chemical inventory done in all storage areas and classrooms. Discard hazardous materials or empty containers of hazardous materials in a manner consistent with environmental statutes and regulations. Follow proper procedures for storing and securing hazardous materials. Obtain Material Safety Data Sheets (MSDS') for chemicals from manufacturers or suppliers.
15. Maintain these MSDS' and train individuals in the proper use, storage and protective measures for each material in a manner consistent with the Massachusetts Right-To-Know Law, M.G.L. c. 111F (MGL, 1983).

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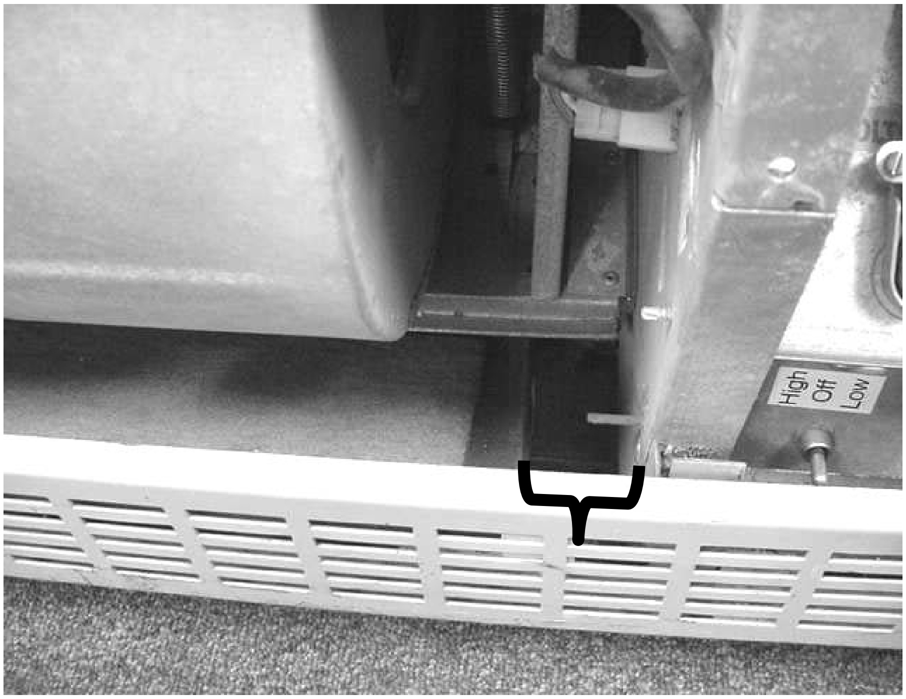
Picture 1

An Exhaust Vent Is Located In Close Proximity To The Univent Fresh Air Intake Of Room H24

Picture 2

Potted Plant On Library Carpet

Picture 3



Undersized Filter in Univent

Picture 4

Tennis Balls On Stool Legs

Picture 5

Wood Dust Collector Univent Fresh Air Intake

Wood Dust Collector in Close Proximity to Room E-1 Univent Fresh Air Intake

Picture 6

Jewelry Kiln On A Counter

Picture 7

Paint Thinner Stored On Top Of Flameproof Cabinet

Picture 8

Eyewash Station

TABLE 1

Indoor Air Test Results – Mount Everett High School, Sheffield, MA – April 3, 2002

Location	Carbon Dioxide *ppm	Temp. °F	Relative Humidity %	Occupants in Room	Windows Openable	Ventilation		Remarks
						Intake	Exhaust	
Outside (Background)	422	42	68					4:00 pm
Main Office	517	74	37	1	Yes	Yes	Yes	Door open
G30	630	74	42	10	Yes	Yes	Yes	Window open, dry erase board
H23	865	76	44	15	Yes	Yes	Yes	Window and door open, dry erase board
H24	1121	76	44	16	Yes	Yes	Yes	Univent fresh air intake 5 feet from exhaust vent, dry erase board
H25	780	76	42	19	Yes	Yes	Yes	Dry erase board, floor fan
H26	662	76	41	10	Yes	Yes	Yes	Window and door open, dry erase board
H1	672	75	41	19	Yes	Yes	Yes	Window open, dry erase board
H2	547	76	75	23	Yes	Yes	Yes	Window and door open, dry erase board
H4	582	75	41	23	Yes	Yes	Yes	Window and door open, dry erase board
H8	527	75	39	3	Yes	Yes	Yes	Window and door open, dry erase board

*** ppm = parts per million parts of air**
CT = ceiling tiles

Comfort Guidelines

Carbon Dioxide -	< 600 ppm = preferred
	600 - 800 ppm = acceptable
	> 800 ppm = indicative of ventilation problems
Temperature -	70 - 78 °F
Relative Humidity -	40 - 60%

TABLE 2

Indoor Air Test Results – Mount Everett High School, Sheffield, MA – April 3, 2002

Location	Carbon Dioxide *ppm	Temp. °F	Relative Humidity %	Occupants in Room	Windows Openable	Ventilation		Remarks
						Intake	Exhaust	
H13	561	76	40	7	Yes	Yes	Yes	Window and door open, dry erase board
H17	584	76	40	3	Yes	Yes	Yes	Window open, 2 water-damaged CT, 20 computers
H14	490	75	40	9	Yes	Yes	Yes	Window and door open, dry erase board, cardboard obstructing univent
H21	498	74	40	9	Yes	Yes	Yes	Window and door open, dry erase board, cardboard obstructing univent
H22	603	76	42	18	Yes	Yes	Yes	Window and door open, dry erase board, cardboard obstructing univent
Gymnasium	447	74	43	5	No	Yes	Yes	
E1 – Computer Tech	482	74	39	2	No	Yes	Yes	Wood dust odor
Woodshop					No	Yes	Yes	
E4	782	74	40	13	No	Yes	Yes	16 computers

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Relative Humidity -	40 - 60%

TABLE 3

Indoor Air Test Results – Mount Everett High School, Sheffield, MA – April 3, 2002

Location	Carbon Dioxide *ppm	Temp. °F	Relative Humidity %	Occupants in Room	Windows Openable	Ventilation Intake	Ventilation Exhaust	Remarks
E5 – Home Ec.	740	74	42	14	Yes	Yes	Yes	4 stoves, 3 water-damaged CT
Cafeteria	715	72	42	100+	Yes	Yes	Yes	Window open
Library	793	73	41	25	Yes	Yes	Yes	Plant, old water-damage,
F4 – Band Room	461	73	37	0	Yes	Yes	Yes	1 CT ajar
F3	689	73	39	2	Yes	Yes	Yes	Window open
G18	617	73	39	0	Yes	Yes	Yes	Univent off, dry erase board, door open
G19	758	75	44	19	Yes	Yes	Yes	Eye wash, floor drain, door open to greenhouse
Greenhouse							Yes	Exhaust deactivated
G21	629	76	42	14	Yes	Yes	Yes	Window open, univent off, dry erase board, 2 water-damaged CT
G23	630	75	40	5	Yes	Yes	Yes	Window open, dry erase board
G22	977	76	40	11	Yes	Yes	Yes	Univent off, dry erase board

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Temperature -	70 - 78 °F
Relative Humidity -	40 - 60%

TABLE 4

Indoor Air Test Results – Mount Everett High School, Sheffield, MA – April 3, 2002

Location	Carbon Dioxide *ppm	Temp. °F	Relative Humidity %	Occupants in Room	Windows Openable	Ventilation Intake	Ventilation Exhaust	Remarks
G20	820	75	42	17	Yes	Yes	Yes	Univent off, dry erase board
G16	481	74	42	17	Yes	Yes	Yes	Univent off, dry erase board, window and door open
G14	682	42	42	15	Yes	Yes	Yes	Water-damaged CT, dry erase board, window open, univent off
Chorus Room Office	694	73	40	1	No	No	Yes	
F1	801	74	41	17	Yes	Yes	Yes	Window open, 3 water-damaged CT, dry erase board
D14 – Art Room	538	73	39	3	Yes	Yes	Yes	
D1 – Pottery	438	71	38	0	Yes	Yes	Yes	Window open, jewelry kiln
D16 – Art Room	560	72	40	6				

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